A BRIEF REVIEW
OF THE

Fisheries

OF

NEW SOUTH WALES

Present and Potential

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A BRIEF REVIEW
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THE FISHERIES
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NEW SOUTH WALES:
PRESENT AND POTENTIAL.

By

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THE FISHERIES OF NEW SOUTH WALES: PRESENT AND POTENTIAL.*

BY
DAVID G. STEAD.

FOREWORD.

WHEN one thinks of fisheries, he naturally conjures up fishes; as, although in certain restricted localities, it might not apply, speaking generally, fishes are by far the most important product of the sea; and there is no doubt in my mind, that *our* economic fishes will always occupy at least the same position of importance in relation to other branches of our fisheries, as they do to-day. It may be at once rightly assumed, however, that the value and importance of the present fisheries of the State of New South Wales are practically as nothing compared to the vast possibilities which the future holds. One would really expect this to be so in any country where (apart from the freshwater) as in New South Wales, practically only the resources of the estuaries had been tapped; and even those but slightly. I mean by that, that he would expect it even without the possession of any specific knowledge as to the kinds and quantities of fishes, &c., inhabiting our coastal ocean waters; and, judging by analogy he would be quite justified in his expectations.

The present fisheries of New South Wales embrace within their scope—(1) Fishes, (2) Crustaceans, (3) Mollusks, and (4) Cetaceans (whales and dolphins); to these should be added in the near future, Sponges and Seaweeds—or more properly Marine Algæ. Of the two branches here mentioned as not yet exploited, our seaweeds, I think, may probably take the more prominent position.

*Presidential address read before the New South Wales Naturalists' Club under the authority of the Board of Fisheries for New South Wales, on the 5th August, 1909.

FISHES.

New South Wales has a known fish-fauna of not less than 550 species. Of these at least 250 are of a good, edible character. By the term "edible" here, I mean—as explained by me in my "Edible Fishes of New South Wales"—"all of those fishes which—while not being of a noxious or unpleasant character (such as Toad-Fishes, Porcupine-Fishes, &c.)—attain a marketable size, or else occur in sufficient abundance to render them of use as adjuncts to our food supply." It may be reasonably expected also that as time goes on our already long list will receive many additions; more particularly from the ranks of certain gregarious oceanic or pelagic species which have thus far escaped observation and record. However, we have no need to consider here any possible additions.

During the last few years an average annual amount of not less than 10,000,000 to 12,000,000 lb. of fresh fish has passed through the fish markets, while, in addition, a very large quantity (probably not less than 3,000,000 to 4,000,000 lb.) was disposed of without passing through any recognised market, and consequently without being recorded. The most important kinds of those at present marketed are as follows:—Snapper, Black Bream, Blackfish, Whiting (Sand and Trumpeter), Mullet (Sea, Flat-tail, and Sand), Jewfish, Flathead, and Murray Cod.* More than nine-tenths of the whole supply is obtained from the coastal estuaries and bays, while the great ocean resources are practically untouched.

As I have pointed out elsewhere† *it does not follow that fishes which are now of the greatest importance, will still occupy that relative position in our future fisheries.* Quite the reverse, in fact, is the conclusion which a close study of our fishes brings us to. There are many fishes which are not at present

* With better facilities for transport, the Murray Cod industry is capable of enormous expansion.

† 'Edible Fishes of New South Wales" (1908), p. 9.

of any special importance in the fisheries of New South Wales —fishes which, though present in our coastal waters in incalculable numbers, are not usually captured unless they make their appearance in the more restricted waters of our harbors and estuaries; that is, in other words, unless they practically "walk into the net." But, apart from these altogether, those species at present of the greatest economic importance in our fisheries, may be captured in quantities immensely greater than those at present disposed of.

I take it that in any country the people (with few exceptions) first make the acquaintance of inshore (*i.e.*, estuarine and harbor) fishes; at least as a source of food supply. This is governed largely by convenience; as, so long as the fishes can be obtained in sufficiently large quantities at the door—so to speak—there is no special incentive to go farther afield. In this connection, inshore fishes would really include as well, such oceanic forms as at times swarm close along our shoreline and actually throw themselves within the very limited scope of the so-called "hauling-nets" or short seines.

In New South Wales the domestic demand, *as far as the market demand* is concerned*, is easily supplied with fishes from the estuaries and bays. The actual portion of the New South Wales coastline upon which netting is constantly carried out is really astonishingly small.

At certain times of the year, much larger quantities of fine food-fishes, such as the well-known and important Sea Mullet, for instance, would be brought in to market; as, in many cases, only the fringe of the vast shoals is touched or drawn upon; but, owing to a want of proper distribution—on a really great and far-reaching scale, I mean—the fisherman is practically obliged, in his own interests, to refrain from sending what he might, for fear of creating a "glut."

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* I purposely differentiate here between the *market* demand and the actual, because a large proportion of our people really desire a constant and regular fish supply most ardently, but because a complete system of distribution has not yet been mastered, they have practically or wholly to go without.

(Of course, this could be carried to excess, and I do not attempt to defend any improper methods of controlling the output of our edible fishes.)

With the opening up of proper avenues of disposing of fish, an enormous impetus would be at once given to production (as represented by the fishermen); and if, coincidently with these, large canning establishments were established—and these would inevitably result—it would very soon be found necessary, while it would be at once more convenient, to go to the ocean waters with their inexhaustible supplies of the fishes which are more especially eminently suitable for preparation in canneries and "salteries," &c. I am thinking here chiefly of such species as the Australian Pilchard, Sandy Sprat, Anchovy, Tailer (which is the American Blue Fish), Samson Fish, Cowanyung, Kingfish, Trevally, Mackerel, Horse Mackerel, Bonito, Little Tunny, Southern Tunny, and the highly important Spanish Mackerel of the genus *Scomberomorus*—fishes of large size, known to be of great edible value in the world at present, but which we simply "do not bother about."

In the development of fisheries—at least as far as the fishes themselves are concerned, canneries and large salting establishments are almost a necessary adjunct; because at times much larger quantities of fishes are captured than can possibly be disposed of in the fresh or frozen condition within a reasonably short period.

That there is ample room for expansion in this direction is fully demonstrated by a short review of our huge imports of canned, salted, and otherwise preserved fish and fish-products. The few attempts at the establishing of canneries on this coast have been defeated, it seems to me, perhaps more than anything else, by an intermittent supply (brought about by conditions which need not be discussed here). I might say, however, that all fish canneries here should employ their own fishermen in order to ensure a continuous supply.

I do not wish to discuss here special methods of preparation, but would like to draw attention to the already large amount of Mullet and other species of our fishes (principally

the former) which is at present smoked. This branch of the industry alone is capable of enormous expansion; and there are fishes, such as the abundant Cowanyung (*Decapterus leptosomus*) which, though they " take the smoke " admirably and make a first-class product, are practically untouched.

Along with any increase in our fisheries should go the establishment of fish-oil and fish fertiliser factories; for which there are great possibilities in our country. (In this connection I would refer the reader to the chapter on " Fish Economics " in my " Fishes of Australia," where the matter has been more fully dealt with.) In connection herewith, also, mention should be made of the great use which might be made of the great hordes of predaceous sharks which frequent our shores in the warmer months. Not only would this refer to the production of oil and fertiliser, but to the use of the skins and also of the fins, in which there is really quite an insignificant trade at present.

Much more might be written here, but as it is my purpose to give only a brief review of the matter, and there are other important branches of the fisheries to deal with, I must pass on. Before doing so, however, it will be useful, as well as of general interest, to give a few authentic records of catches of some of our edible fishes at various times, during the last few years. These are taken from the weekly reports of the various Inspectors of the Department of Fisheries*, and they refer in each case to the product of *one haul*, or draw of the net, only.

* The reports here referred to were initiated by me, under the Board of Fisheries in 1902. As I will be able to show at no distant date, I hope, they contain a great mass of valuable data referring to the periodicity, movements, breeding habits, &c., of our fishes. The complete working up of the material, will, however, take some time.

Quantity of Fish captured in One Haul of the Net (unless otherwise stated) on various parts of the coast of New South Wales.

SNAPPER (Schnapper).*

Quantity.	Date.	Locality.
104 (weighing 1,932 lb.)	24/6/08	Port Stephens.

BLACK BREAM.

60 baskets†	1/8/08	Wallis Lake.
12 ,, ...	24/8/08	Tuggerah.
30 ,, ...	13/6/08	Hawkesbury River (Broken Bay).
96 ,, ...	28/4/06	,, ,,
74 ,, (in two consecutive hauls)	28/4/05	,, ,,
15 ,, ...	6/4/07	Botany Bay.
90 ,, ...	13/5/05	Port Hacking (entrance).

BLACKFISH.

50 baskets	12/10/07	Wallis Lake.
100 ,, ...	30/6/06	,,
70 ,, ...	3/6/05	,,

MULLET.

85 baskets	1/8/08	Clarence River.
60 ,, ...	30/3/07	Port Macquarie.
50 ,, ...	28/8/09	Wallis Lake.
50 ,, (in *each* of two hauls) ...	7/8/09	,,
20 ,, ...	31/7/09	,,
70 ,, ...	20/7/07	,,
30 ,, ...	26/5/06	Tuggerah.
70 ,, ...	7/4/06	Hawkesbury River.
70 ,, ...	15/4/05	,, ,,
110 ,, ...	30/4/06	Port Jackson.
20 ,, ...	3/4/09	Botany Bay.
15 ,, ...	13/3/09	,,
55 ,, ...	23/5/04	,,
65 ,, ...	23/5/04	,,
200 ,, ...	17/4/09	Port Hacking.
20 ,, ...	27/3/09	Bateman's Bay.
120 ,, ...	20/3/09	,,
70 ,, ...	8/7/05	,,

*As is well known, this species, being a line fish, is not usually captured in the hauling-net; and this was a most exceptional occurrence. At the same time, it is probable that large catches will be made in the future with the trawl-net while the fish is on sandy ground. Great numbers of large Snapper are taken by line by fishing parties out in tugs. Here is a typical record made by the Fisheries Inspector at Wallis Lake, 10th April, 1909:—"A party of eleven caught 450 Snapper on the 8th instant."

† Each basket holds from 75 lb. to 80 lb. of fish.

GARFISH.

Quantity.	Date.	Locality.
22 baskets	7/8/09	Wallis Lake.
30 ,, ...	31/7/09	,,
35 ,, ...	27/6/08	Tuggerah.
35 ,, ...	9/6/06	,,
30 ,, ...	2/6/06	Coogee.

SAND WHITING.

35 baskets	7/8/09	Botany Bay (George's River estuary).

(Of course, there have been very many other good catches of Whiting, but they are principally noted as either the catch for the day, or the total catch for the whole week.)

JEWFISH.

300 "large fish" in one haul ...	4/5/07	Wallis Lake.
230 "extra large," taken in one haul, out of shoal of 500 captured.	13/1/06	Lake Illawarra.
250 fishes, averaging about 25 lb. weight each, caught in one night with a 30-yard net!!	21/1/05	Port Stephens.

MIXED FISH.

200 baskets	4/7/08	Panbula.

In no case here quoted does the quantity given as having been caught in the one haul really indicate the size of the shoal that may have been present at the one time.

These catches were all made with nets not exceeding 200 fathoms (1,200 feet) in length, while the Garfish is caught with a net not exceeding 150 fathoms in length.

CRUSTACEANS.

The Crustaceans which at present find a place in the fisheries of New South Wales are as follows:—Two species of marine Crayfish or Spiny Lobster of the genus *Palinurus* (*P. hugelii* and *P. edwardsii*); one Freshwater Crayfish—or "Murrumbidgee" Crayfish as it is called—(*Astacopsis spinifera*); not less than half-a-dozen species of Prawn of the genus *Penæus*, of which the principal are (1) the School Prawn (*P. macleayi*), (2) the King Prawn (*P. canaliculatus*), and (3) the Tiger Prawn (*P. monodon*); two species of Shrimps or "Long-armed Prawns," of the genus *Palæmon*, one from the estuaries and the other from the rivers; and five species of Swimming Crab, as follows—(1) the Blue Swimming Crab (*Lupa pelagica*), (2) the Mangrove Crab (*Scylla serrata*), (3) the Two-spotted Swimming Crab (*Ovalipes trimaculatus*), (4) the Blood-spotted Swimming Crab (*Lupa sanguinolenta*), and (5) the Cross-bearing Swimming Crab (*Charybdis cruciatus*). In addition to the foregoing there are two other large crayfish-like crustaceans of some slight edible importance—*Scyllarus sculptus* and *Ibacus peronii*; but these do not at present appear in any considerable numbers.

As will be seen from the above, New South Wales is well supplied with edible forms of Crustacea, and no doubt the future will produce a number of others of economic importance, even from the ranks of those which are at present of no special value, while the possibilities of augmenting the supplies of those species at present known and used are really enormous.

Quoting from my recently published "Edible Fishes of New South Wales," we find that in the year 1907, in round numbers, nearly 85,000 Crayfishes,* and 187,000 quarts of

* In 1908 this number was greatly exceeded, reaching a total of more than 133,000 crayfishes.

edible Prawns passed through the recognised markets in New South Wales. In addition, of course, we have to reckon with a very considerable amount of each which entered into consumption without passing through the markets, and of which, consequently, we have no record. These are no mean figures when it is considered that it is generally recognised that we are really only on the threshold of the industry, and it should convey to people some idea of what may be expected with organised effort on a large scale. Though I look for an exceedingly great future augmentation in the supply of the Marine Crayfishes, I anticipate that the greatest amount of development will be in connection with our edible Prawns, which occur in many of our estuaries in really prodigious numbers; and here there will be a great field for the operation of canning and drying these Crustaceans—apart from an increased output in the fresh state.

I have no fully worked up figures by me just now, as regards the number of edible Crabs forming the present annual supply. But it is fairly considerable, though our resources in this respect are only just tapped.

Very large numbers of the common Freshwater Crayfish are captured and disposed of in country towns, and a considerable number of Freshwater Shrimps also; but at present I have not sufficient data to enable me to make an estimate. A comparative few of the former are sold in Sydney.

I might add also that in many parts of our western country the little Freshwater Crayfish, known familiarly under the name of "Yabbie" or "Yabby" (*Chæraps bicarinatus*), is occasionally used as an adjunct to the food supply; but it is quite unimportant.

Appended are a few general notes on the principal edible Crustaceans of this State. At the same time, I may mention that as soon as opportunity offers, I propose to publish a well-illustrated popular and descriptive account of these and some other Crustaceans.

CRAYFISHES (Lobsters).

(1) **Common Crayfish,** *Palinurus* (*Jasus*) *hugelii* Heller.

This is the ordinary form of crayfish so commonly seen in our markets. It is fairly abundant over the whole of our coastline, particularly from Port Stephens on the north to Bateman's Bay on the south. Its capture is effected mainly by means of lobster-pots. Young specimens of this kind are of a deep olive-green usually, though an occasional specimen of a deep reddish-brown is obtained. As they grow large, and after becoming sexually mature, the yellow mottlings, which at first are only apparent on the lower surface, begin to spread up over the sides and around the "head," the rest of the body being of a very much lighter green than that which prevails in the younger examples.

(2) **Southern Crayfish,** *Palinurus* (*Jasus*) *edwardsii* Miers.

This crayfish is not often seen alive in our markets, but a great many are brought up from Victoria and Tasmania in a boiled state. It is a true southern form, occurring very plentifully on the coast of Tasmania, and also in New Zealand. On our own coast it begins to be abundant about Eden. It is not altogether uncommon at Bateman's Bay, and occasional examples of this species are obtained in Port Jackson and Botany Bay. It is even found to the northward of Port Stephens, and during August of the present year was obtained there in some numbers. In its living state it may at once be distinguished by the tyro from the common crayfish by its general reddish tint, and by the fact that all over its body around the base of every protuberance or tubercle, are stiff, short, reddish bristly hairs, whereas on the body parts of the common crayfish there are no hairs at all. Another very helpful and noticeable feature is that all the segments of the abdominal or tail-portion in this species have the upper portions beautifully sculptured, while in the common crayfish, with the exception of a few pointed tubercles or roughnesses, the backs of these segments are quite smooth.

For the benefit of naturalists and others who might desire to critically compare these two crayfishes, a closer description of them is here appended:—

(1) **Common Crayfish**, *Palinurus hugelii* Heller.

Carapace (body).—Armed generally with acute short spines of varying heights, with the exception of the fore part, which possesses five very large ones, the first in the centre and forming the rostrum or beak, one on each side above the eyes, of about the same size as the rostrum, and one under each eye a little smaller than the three just mentioned. The spines are generally relatively smaller, flatter, and not so acute in larger specimens. The carapace is without setæ (hairs) with the exception of a short fringe on the hinder margin. (Rostrum as large as spines above eyes.)

Abdomen (tail).—Fairly uniformly smooth and without setæ, with the exception of a fringe along the hinder margin of each segment. Small specimens usually have the segment pitted here and there on their upper surfaces with small depressions, larger ones possessing, in addition to these pits, small roughnesses or tubercles, the pits becoming usually somewhat reduced in number.

Telson.—(This forms the middle flap of the tail, properly so called). Spiny. Without setæ.

Eye.—Rather elongate.

Upper surfaces of legs.—Smooth and devoid of setæ. A small spine upon the end of the third joint of each leg, most prominent on the first pair.

(2) **Southern Crayfish**, *Palinurus edwardsii* Miers.

Carapace (body).—Armed with spines, these being more acute and longer than in *Palinurus hugelii*. There are five spines on the front margin corresponding to those of *Palinurus hugelii*, but the two above the eyes (supra-orbitals) are by far the largest, and a good deal larger than the supra-orbitals in the latter species. The central spine forming the rostrum is usually small and insignificant and strongly curved upwards. Each spine, large or small, of the carapace is almost surrounded with a fringe of setæ (hairs). (Rostrum much smaller than spines above eyes.)

Abdomen (tail).—All of the segments are sculptured or excavated, leaving broad flat irregularly oval or oblong eminences, each of these being partly surrounded by a fringe of setæ.

Telson.—(This forms the middle flap of the tail, properly so called). Spiny; spines more numerous than in *Palinurus hugelii*. All spines partly surrounded by a fringe of setæ at their bases.

Eye.—Short and thick.

Upper surfaces of legs.—Rough; covered with several series of low flattened and somewhat rounded tubercles; a fringe of setæ in front of each tubercle. A spine upon the end of the third joint of each leg, more prominent and acute than in *Palinurus hugelii*. The spines of the first pair of legs are scarcely more prominent than the others.

CRABS.

(1) **Blue Swimming Crab,** *Lupa pelagica* (Linnæus).*

This species is by far the most common of our edible crabs; being, in fact, the only one that is constantly represented in our markets. This, like all our other edible species, is a true swimming crab; having the legs flattened, and the last pair turned into flat paddle-shaped organs, to adapt it for a natatorial existence.

(2) **Mangrove Crab,** *Scylla serrata* (Forskâl).

This species is quite common along our coast—more particularly on the northern portion. It is really a typical tropical species, being still more abundant on the Queensland coast. In Queensland it is often known as the Wide Bay Crab, on account of its abundance in the bay of that name. It does not come into our markets nearly so often as the preceding, nor in anything like the numbers; consequently, as it attains a very large size—being by far the bulkiest of our crabs—it always commands a ready sale and a high figure. In color it is of a deep olive-green or dark brown. It usually occurs in shallow water; and, as its name implies, on mangrove mud-flats, where it is often to be found, in basin-shaped hollows excavated out of the mud.

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*In a paper dealing with the structure of this crustacean, which I read before the Linnean Society of New South Wales in 1898, I dealt with the peculiar form of the pleon or "tail" of what I termed in the body of my paper the "sterile" female, but which I mentioned at the time might simply be the "immature" female. Such is the case and *all* the females pass through the stage described therein. (*Vide* "Proceedings of the Linnean Society of New South Wales, Vol. xxiii, 1898.)

(3) **Two-spotted Swimming Crab,** *Ovalipes trimaculatus* (de Haan).

This crab is not brought to market very often; not, however, because it is not common, but because only the largest specimens of the kind are of a sufficient size to be considered marketable, and as no special fishery for the species exists, large ones are not often caught. It is quite common along our coast in shallow water, on clean sandy beaches; into which it buries itself. It may be at once distinguished by the somewhat rounded outline of the carapace, and the possession of two irregular red spots, one on either side near the posterior edge of the shell, the rest of the carapace being yellowish.

(4) **Blood-spotted Swimming Crab,** *Lupa sanguinolenta* (Herbst).

This species is closely allied to the common Blue Swimming Crab, to which it is very similar in shape, though in coloration it is quite distinct, being at once easily recognised by the three remarkable blood-like spots surrounded by blueish rings, which are to be found on the back shell or carapace. Like most of the members of this group of crabs, it is very widely distributed, but it is not very common here, nor does it attain to the large proportions of the Blue Swimming Crab.

(5) **Cross-bearing Swimming Crab,** *Charybdis cruciatus* (Herbst).

This crab will be at once picked out from others (which are themselves beautiful) by the glorious and delicate colors. On the carapace, and running from front to back, are several milk-white or cream-colored bars, the central ones of which are thought by some to bear a striking resemblance to a cross. I must confess that I have never been able to see the resemblance. The whole shell of this lovely animal is so finely smoothed and so delicately colored that it rather suggests the finest porcelain than a crab's shell. The species is not at all common in our waters.

PRAWNS.

(1) **School Prawn,** *Penæus macleayi* Haswell.

This is the commonest of our edible prawns, and is the one usually sold by hawkers throughout the coastal districts generally—especially Sydney and Newcastle. It occurs in tremendous abundance on muddy bottoms in water of from 3 or 4 fathoms up to tide limits. It is semi-transparent when alive, and is covered with small reddish spots. It does not attain anything like the size of the two following species.

(2) **King Prawn,** *Penæus canaliculatus* Olivier.

This handsome species is, from an edible point of view, our finest prawn; as it attains commonly a very large size (as much as 8 or 9 inches in length), hence its vernacular name. When alive, it possesses the most lovely tints, more especially upon the swimmerets and tail. It is caught in some abundance upon fairly deep muddy bottoms (by means of a sunken net), though it often comes to the surface at night and skips about. Though it lives in very much deeper water than the School Prawn, it will survive for a very much longer time out of water than the latter. It has a wide distribution, and is one of the edible prawns of Japan.

(3) **Tiger Prawn,** *Penæus monodon* Fabricius.

This large prawn is not usually obtained in numbers like the preceding two. It is a deep-water animal, and has a very similar range of distribution to the King Prawn. It attains an exceedingly large size, specimens of 10 inches and more in length having occasionally been captured. During last year (1908) large numbers of this species were captured off Vaucluse, in the lower part of Port Jackson. These were exceptionally large, some of the specimens reaching the gigantic length of over 12 inches (measured from the tip of the rostrum to the end of the telson). It is a very handsome animal, being beautifully barred with vertical tiger-like brown stripes.

FRESH-WATER CRAYFISH.

Murrumbidgee Crayfish, *Astacopsis spinifera* (Heller).

This is also known as the "Murray River Lobster." It is distributed over the greater part of the western watershed, is also found on the mountains, and is quite common in the County of Cumberland, in the neighbourhood of Sydney. It is, however, in the large western rivers that it attains its greatest perfection and size. This crustacean in coloration varies in different parts and at different stages of growth, from a deep red to a light bluish-grey, the latter being the prevailing tint of the majority of the larger specimens. There is also a great amount of variation in the finer details of external structure. A close study of a large series of specimens from all over the country will probably show that this remarkable crayfish may be differentiated into a number of well-marked groups.

MOLLUSKS.

Of the vast molluscan fauna of New South Wales only one species is of present commercial importance, this being the Common Oyster (*Ostrea cucullata*), which is so well and favorably known for its fine edible qualities. Of the others, at least the following are used for food, though not in any considerable numbers:—The Mud Oyster (which is a variety of the almost world-wide *Ostrea edulis*), several species of Cockle, two species of Saltwater Mussel, as well as a Fresh-water Mussel (*Unio*),* Abalone (*Haliotis*) also known as "Mutton-fish," Ear-shell, &c. (and which is dried and sold by Chinese merchants), a common species of Periwinkle, a species of Whelk (*Potamides*), various Squids of the genera *Sepia*, *Sepioteuthis*, &c., and occasionally the common Octopus. Probably this list could be further extended at the present time, and very probably there will, in time, be a number of additions; it is also highly probable that species of no importance now, will become of very considerable value later on, and when their true worth is recognised. In saying this I am thinking more particularly of Mollusks like the common Mussel, which may be easily and successfully farmed on somewhat similar lines to Oysters, and in many cases in waters or in zones of our littoral, in which the oyster will not flourish. I would like to expatiate at some length upon the importance of a Mussel-fishery in New South Wales, but will have to content myself here with having drawn attention to it, as I wish to deal here more with the very great importance of our State Oyster-fisheries. These are now of great value, and there is every indication of a gradual increase in their importance. At the present time nearly 20,000,000 of

*The common Fresh-water Mussel of our western river system occurs in prodigious numbers, and grows to a large size (5 to 6 inches or more in length). It is bound to come into prominence later on, both because of its edible value and its useful shell, which attains a considerable thickness, takes a beautiful polish, and is well suited for button-making and for ornamental pin-trays, ash-trays, salt-cellars, as well as for many other purposes.

Oysters (above 2 inches in length) are annually taken off the New South Wales oyster-beds. When it is considered that this is to a great extent the result of artificial cultivation, it is highly gratifying. In the introductory portion of my "Edible Fishes of New South Wales," I stated that "although this number* very strikingly indicates the present importance of the industry, it may be safely stated that, when all the oyster lands are treated in the same way as a comparative few are at present, the output will be at least quadrupled." I have since thought that I put it far too mildly in using the word "quadrupled." I think really that there would be no exaggeration in saying that the output might be multiplied by twenty—and even then I only refer to areas at present under lease. In addition there are immense areas along the foreshores of some of our estuaries, which, while they do not naturally grow an oyster at present, might, by a method of scientific culture, be turned into great and profitable oyster-farms.

I would like to touch upon some of the methods of culture at present in vogue in our waters, but must reserve it for another place.

In saying that the oyster output might be greatly increased let it not be thought that the oystermen of New South Wales are sluggards, or naturally slow to perceive opportunities—but what they need (as already publicly acknowledged by many of them) in common with our fishermen, is a grand system of education, and their interest in a study of the subject should be fostered by means of lectures and by publications distributed freely among them. Experimental oyster farms should also be established under Government control on somewhat similar lines to, and with the same objects as our Agricultural Stations. At these places, various methods of oyster-culture would be tried, the natural enemies of the oyster would be studied, and means for holding them in check or eradicating them would be experimented with.

* The number I referred to there was "nearly 17,000,000." Last year, however, the quantity was greatly in excess of that, and production is undoubtedly on the increase.

Even as it is, a great deal of knowledge on various points, in the possession of many men, spread over wide areas, absolutely goes to waste for want of correlation. *The mere collation of this knowledge for general dissemination among our people will be a very big step in the right direction.*

I may mention here, in passing, that the Board of Fisheries for New South Wales some time ago entrusted me with the task of making a general investigation into our oysters and the oyster question generally, but under existing circumstances, though a very large amount of valuable information and material have been got together, progress must be necessarily very slow. To carry this great and important national work out to anything like completeness some very special permanent provision—financial and otherwise—will be necessary.

The following list of New South Wales Oyster Waters should prove of some general interest here :—

New South Wales Oyster-bearing Waters, in which Oyster-leases exist at present (March, 1910), from North to South, along Coast.

Note.—Those marked with an asterisk are at present the most important Oyster waters.

Tweed River and Terranora Creek.
Cudgara Creek.
Brunswick River.
Richmond River.*
Evans River.
Clarence River.*
Sandon River.
Wooli Wooli River.
Woogoolga Creek.
Moonee Creek.
Coff's Harbour Creek.
Bonville Creek.
Boambee Creek.
Bellinger River.*
Deep Creek.
Nambucca River.*
Oyster, and McGrath's, Creek.
Macleay River.*
Hastings River (Port Macquarie).*
Cathie Creek.
Camden Haven.*
Manning River.*
Khappinghat Creek.
Wallis Lake.*
Port Stephens.*
Hunter River.*
Brisbane Water.
Hawkesbury River.*
Pitt Water.
Narrabeen Lagoon.
George's River.
Port Hacking.
Crookhaven River.*
Kurrarong Creek.
Callala Creek, Cararma Creek } Jervis Bay.
Currambene Creek.
Sussex Haven.
Narrawallee Creek.
Clyde River.*
Tomaga River.
Candlegut Creek.
Moruya River.
Congo Creek.
Tuross Lake.
Wagonga River.*
Bermaguee River.
Murrah River.
Wapengo Lake.
Nelson Lake.
Bega River.
Merimbula Lake.
Panbula River.*
Nullica River.
Kiah River.
Wonboyn River.
Merrica Creek.

CETACEANS (Whales and Dolphins).

Quite a number of Cetaceans roam the waters of our seaboard. Among the Whales are (1) the Southern Right Whale, or Black Whale (*Balæna australis*), which, by the way, seems to be very little different to the North Atlantic Right Whale (*B. glacialis*); (2) the Hump-back (*Megaptera*); (3) the Common Fin-back, or Black Fin-back (*Balænoptera physalus**); (4) the Sulphur-bottom (*B. musculus**); (5)† the Little Piked Whale, also known as Pike Whale, and in parts as "Grampus" (and which appears to me to be identical with *Balænoptera acutorostrata*); (6) the large Sperm Whale (*Physeter*); and (7) the little Pigmy Sperm Whale (*Kogia breviceps*). I also have a report of a Grey Fin-back, from Twofold Bay, which is very likely another species of large Rorqual. There is also a small Whalebone Whale allied to the Black Whale, and known under the generic name of *Eubalæna*.

Among the Dolphins, the most abundant form is, of course, the common Porpoise—so called. This is the Common Dolphin (*Delphinus delphis*). Then there is the Bottle-nosed Dolphin‡ (*Tursio*), which appears to be fairly abundant; and the great "King of the Dolphins" the Killer (*Orca gladiator*), which preys largely upon the various species of whale.

Many years ago Sydney was a whaling port of very considerable importance, a number of whalers making it their headquarters. Though this was so, the whales were not necessarily captured on the coast of New South Wales, as the vessels in some cases made long voyages. Nowadays, the only whaling industry carried on in New South Wales waters is that at Eden, Twofold Bay, though whales are

* These two large Rorquals are generally known here under other specific names, but they do not seem to be specifically different from the two well-known Atlantic forms recognised under the names here given.

† Numbers 1–5 are all "whalebone," or "baleen," whales, as distinct from the sperm whales, which are "toothed."

‡ Not the Bottle-nosed Whale (*Hyperoödon*), which also occurs in Australian waters.

often to be found in very considerable numbers off various portions of our coast. Twofold Bay has been a whaling station for many years, and a considerable trade results from the operations of the two whaling parties living and working there. The whales are captured primarily, of course, for their oil; whalebone or baleen also being an important product. A valuable agricultural fertiliser could be made from their carcases after the blubber or "blanket" is taken off, but at present this is not done.

In the capture of the various species of Whales, the Twofold Bay whalers are greatly assisted by the Killers or Killer-Whales (*Orca gladiator*), which harass and pursue the Whales, usually clustering about the head and hanging on to the lower lips in an attempt to force open the leviathan's mouth, with the object of getting at its huge tongue, which is their special titbit. The Killers hem the Whales in towards the shore so that the latter are caught between the whalers and them.

Among the whales captured at Twofold Bay are the following species:—The Black Whale (*Balæna*), the Hump-back (*Megaptera*), the Sulphur-bottom, the Black Fin-back, and the Little Piked Whale or so-called (locally) Grampus; the three last of the genus *Balænoptera*.

Mr. James Morgan, the editor of the "Eden Observer," and a very keen observer of the whaling in those parts, informs me that the average size of the Black Whales captured is about 50 feet; the largest in many years having been 59 feet. The Hump-backs average 45 to 50 feet. The Sulphur-bottom is far-and-away the hugest beast of our waters, growing to a length of about 100 feet. One captured at Twofold Bay in September, 1908, measured no less than 98 feet. This was a "cow," and Mr. George Davidson, who secured it, tells me that she became stranded through her maternal solicitude for her "calf," itself no less than 45 feet long, and which had previously become stranded. It is said that some years back, Mr. George Davidson, the veteran whaler, saw a female about 100 feet long, with a "baby" about 45 feet in length by her side. The Black Fin-back

is very common, but not so valuable, as the blubber is very thin; it also grows to a large size. The small Rorqual, known to the Twofold Bay men as "Grampus," is not uncommon. It attains a length, exceptionally, of 30 feet.

The following statistics in regard to the whaling at Twofold Bay during the last six years have been collected by the local Inspector of Fisheries :—

Year.	Number of whales captured.	Amount of oil produced.	Whalebone taken.
1904	10	25½ tuns	1½ cwt.
1905	6	21 ,,	(Not stated)
1906	8	20 ,,	4½ cwt.
1907	(Figures not available)		
1908	5	19 tuns	4½ cwt.
1909	10	23 ,,	2 ,,

In the year 1905, 17 cwt. of whalebone was sent to Lewis and Peat, of London, where it realised £1,200.

Dolphins.—In addition to the whaling, there is at the present time a small industry in connection with the capture of our common Porpoise, or Dolphin. The Dolphin-fishing is carried out somewhat spasmodically by two or three crews only, and in the vicinity of Port Jackson and Botany Bay. Practically the sole object of the fishery just now is the obtaining of the numerous conical teeth (of which a full set consists of about 160). These teeth are purchased by various firms having business with the Solomon Islands, and some others of the Pacific Islands, as well as parts of Papua, where—strange to say—they are regularly used as currency. At present the demand for these teeth is much greater than the supply forthcoming, notwithstanding the abundance of these Cetaceans, and the ease with which they are captured. While this demand lasts there is very evidently a great opportunity for a great increase in the Dolphin-fishery, apart from the return to be obtained from the skins, oil, as well as from fertiliser obtained from the carcases. The price paid by island firms for Porpoise teeth, as they are called, ranges from 8s. to 9s. per 100. One party of fishermen, operating from Botany Bay, obtained in a few months, and sold in two lots no less than 16,000 of these teeth. During the same period they pursued their ordinary calling as fishermen.

SPONGES.

The sponge fauna of New South Wales is a very large one, but so far it has been very imperfectly worked out, though a number of highly-valuable descriptive papers thereon have been published. Sufficient is known, however, to warrant us in thinking that there is a reasonable prospect of a sponge-fishery being established in our waters in the not-far-distant future. We possess quite a number of species which would be of value for domestic purposes, and probably amongst the others are many which would be suitable for use in various trades.

The most valuable belong to the genera *Euspongia* and *Hippospongia*, and allied forms. Some of the more valuable species grow to a large size, and—as my own experience bears out—they make, even with a very little preparation, very good bath sponges.

There are undoubtedly very large natural supplies of these sponges along our coastline, as indicated by the great numbers to be found on many of our beaches after storms.

Before any sponge-fishery is established here, however, it will first be necessary to carry out a great deal of exploratory work—more particularly in connection with the location of the actual beds and the areas most suitable for sponge-growth.

Sponges are used for a multiplicity of purposes. In addition to the many well-known household uses, the coarser kinds and clippings from better kinds are used for stuffing mattresses and carriage cushions. Others are used for various filtering purposes; others, again, by lithographers.

SEAWEEDS.

There appears to me to be a very great scope for the development of Seaweed industries—and all that that implies—along the coast of New South Wales. At present nothing is done, and, although the development, along economic lines, of our fishes, is of more immediate and pressing importance, we should not lose sight of the great economic importance of our great and varied marine flora. Naturally, those of us who are naturalists find our first interest in the large number of interesting groups and the many exquisitely beautiful species which are found to be included among them, but, while fully sensible of these estimable points of view, it would be foolish of us to ignore their many uses in an economic way, and the part they may play in adding to the material wealth of our native land.

For the purpose of better indicating the value of our Seaweeds as a national asset, I shall here devote a few remarks in regard to some of the various products obtained from them in some other countries.

Scotland, Ireland, France, and almost every European country have at present their Seaweed industries, as has also America; but in none of these has it attained to the great proportions to which the Japanese have developed theirs. Apart from the great quantities used locally in the families of fishermen, the annual value in a commercial way of the Seaweed productions in Japan is over £400,000.* Not only is the natural marine growth relied upon as a source of supply but certain species of seaweed are very extensively farmed and cultivated on somewhat similar lines to those followed in the production of oysters.

The greater part of the marine vegetation is consumed as food, and among sea flora the *Laminaria* (known familiarly to us in a general way as Kelp), often of huge size,

* For a very complete account of the "Seaweed Industries of Japan," the reader is referred to Dr. H. M. Smith's admirable paper in Bulletin 24 (1904), of the U.S. Bureau of Fisheries, and also to Sir F. A. Nicholson's "Note on Fisheries in Japan" (1907).

take perhaps the first place. Under the general name of "Kombu" they are of universal use in the Japanese dietary, though they do not commend themselves in general to European palates. The edible is cut up into small pieces, heated in water, and served as a condiment in broths, or after being sugared or salted, is taken with various fish. One particular species is said to be an excellent substitute for tea with a particularly pleasant fragrance of its own. The importance of the article may be judged by the fact that most of it is used at home, and is only exported to a comparatively small extent to China; yet this export, on an average of ten recent years, annually amounts in a dry state to 57,644,000 lb. It is an industry of long standing, and occupies many thousands of men, women, and children.

Another edible seaweed is the "Amanori," a kind of "Laver" of the genus *Porphyra*, cultivated in numerous places, usually in shallow flats at the mouths of rivers where the water is not very salt, but especially in Tokyo Bay, where the first objects that strike the traveller's notice as he skirts the bay in the train, are the rows of faggots or fascines of bamboo and brushwood on which the weed grows sticking up from the mud. These are placed in position in autumn, and the crop begins in January and goes on to late spring. The plant grows rapidly on the collectors, is gathered from time to time, washed, minced, and dressed into thin brown sheets about octavo size; these are then stuck upon bamboo frames inclined to the sun, and when dry are bundled and sent to market. These are said to be slightly roasted when used and to give a desirable flavor to other foods. It is used in many ways, such as minced and served in broths; a favourite recipe is the well-known Japanese "Sushi," or sandwich composed of boiled rice mixed with fish or pulse flavored with vinegar and wrapped up in a sheet of Amanori. An equally common recipe is to serve it with hot rice and Shoyu (Soy) sauce; it is said to be an excellent appetiser. It does not, however, seem to keep well in the hot weather, but may be dried or canned, when it will keep indefinitely.

Another very important product is that known as Seaweed Glue, called in Japan "Funori," and made principally from marine plants of the genus *Gloiopeltis*. This is used as a stiffening paste or size for woven fabrics, in putting on wall-paper, and in many other ways. Mixed with lime and sand it forms an excellent cement or stucco. The size or glue is easily made by cutting the seaweed into moderate-sized pieces, boiling it for a short time, and then filtering the mass. The filtrate is the desired substance.

Certainly one of the most important products of the seaweed industries is the substance known as Vegetable Isinglass, and called by the Japanese "Kanten." This is pearly white, shiny, and semi-transparent, having in block form a loose, flaky structure, and is tasteless and odorless. In cold water it swells but does not dissolve, but in boiling water it is readily soluble, and on cooling forms a jelly. In the manufacture of this substance probably more than one kind is used, but the recognised plant is a species of *Gelidium*.

In Japan and elsewhere, Kanten (often known under a great variety of names) is used largely for food in the form of jellies (often colored), and as adjuvants of soups, sauces, &c. It is also used for purifying saké, the native wine made from rice. In other countries Kanten is employed in a variety of ways, although chiefly in food preparations where a gelatine is required, such as jellies, candies, pastries, and many desserts, in all of which it is superior to animal isinglass. It is also used for the sizing of textiles, the stiffening of the warp of silks, the clarifying of wines, beers, coffee, and other drinks, the making of moulds required by workers in plaster of Paris, and sometimes in the manufacture of paper. In China one of its uses is as a substitute for edible bird nests. The large consignments of square Kanten to Holland are doubtless destined for the schnapps factories. A very important use in all civilised countries is as a culture medium in bacteriological work; the product is known in the scientific world under the name "Agar-agar," which is the Ceylonese equivalent of Kanten. For this purpose a very pure grade of slender Kanten is required. Other plants beside *Gelidium* are used

in the production of Agar-agar, such as the Australian and Asiatic plants, *Eucheuma spinosum*, *Gracilaria lichenoides*, *G. tenax*, and other related species, which yield the products known in commerce as Agar-agar, Agar-agar gum, Agal-agal, Bengal isinglass, Bengal isinglass gum, Ceylon moss, Ceylon Agar-agar, Chinese moss, &c.

Vegetable isinglass is composed largely of gelose or pararabin, a substance remarkable for its gelatinising properties, which exceed those of any other known product. It is insoluble in cold water, alcohol, dilute acids, and alkalies; its melting point is 90° F. It has eight times the gelatinising power of ordinary gelatine and isinglass; and one part to 500 parts of boiling water forms a jelly on cooling. Gelose jelly keeps well, but owing to its high melting point is not so well adapted for food preparations as some other jellies.

In addition to the kinds of algæ mentioned, very many others are made use of; some being used for the manufacture of jellies, some as vegetables, some in the making of salads, some as condiments, and some for decorative purposes. Large quantities also are used as fertilisers for the soil, while immense quantities are employed in the manufacture of iodine; secondary products being common salt, sodium sulphate, potassium chloride, and sulphur.

The common Sea-grass (*Zostera*) which abounds in the estuaries along our coast is of economic value, though, perhaps, not of much use as a gelatine producer. It is a very useful medium for a "packing" in cases, and is also of value for use in connection with the production of a callus in grape-vine cuttings.

Professor Blunno, the New South Wales viticultural expert, in the Department of Agriculture, has recently used—and with good effect—a large quantity of this Zostera, obtained from Port Stephens. In regard to its use in connection with viticulture, Professor Blunno favors me with the following memorandum:—

"The Sea-grass is used mixed with fine sawdust to line the sides of boxes in which are placed cuttings of phylloxera-resistant stocks that have been grafted with cuttings of

European varieties of grapes. Heat and a certain moisture are necessary for the production by the histologic elements of a callus, which gradually grows and surrounds the zone where stock and scion have been grafted. Before being used the mixture of sea-grass and sawdust is steeped in water. More water is poured on it after the grafted cuttings are laid in layers in the boxes, and the sea-grass, while retaining a suitable amount of that water, lets the surplus escape. The mountain moss was first used instead of the sea-grass, but, apart from being more expensive, had the inconvenience of retaining too much water; with the danger that the cuttings would rot, because the grafted cuttings are kept for about twenty-five days, laid in the mixture at a temperature of from 75° to 78° F. In a word, sea-grass is employed in preference to any porous material like sawdust, mountain moss, or sand, because, like them, it enhances the production of a callus, which is the first stage of the knitting of stock and scion, without having many of the inconveniences of those other substances. When the grafted cuttings are planted in the nursery, and vegetation begins, this callus, which is all a cellular mass and nothing else but parenchyma, begins to harden and to undergo the differentiation of the histologic elements, and by the end of the vegetative period stock and scion form one whole, and the ascension and elaboration of the aliments is then quite normal."

CONCLUSION.

In concluding this necessarily brief sketch of the present and potential value of our fisheries, I cannot refrain from drawing attention to a matter which, though I have previously spoken on it (in another place), I feel sure will bear reiteration. I am confident that I will have your sympathy when I refer to the great and pressing need in Australia for more science and more education in our national life. In all departments of the national concern is this necessity apparent, and this may surely be said without in any way disparaging our present efforts, or whatever has been done in the past. In no branch is its necessity more evident than in dealing with our fisheries matters, in which there lie enormous untrodden fields of research. There is, indeed, so close a relationship between scientific investigation and our fisheries, that I feel justified in claiming that it is really the A B C of it all. This need for constant and close inquiry extends to all branches of our fisheries, its application to our oyster fisheries, for instance, being of very special importance. Upon a proper system of investigation depends very largely indeed the future development of our fisheries, and, at the same time, the fund of information to be so gained will form a strong and sound basis for any future regulations having for their object the effective protection and control of our fisheries.

I am thinking of the words of Professor H. E. Armstrong (quoted by Mr. A. H. S. Lucas in his admirable Presidential Address to the Linnean Society, in March, 1908), when I say that each Department of Government (or at least those connected with our industries) should be "not merely an office," but "also a busy hive of research."

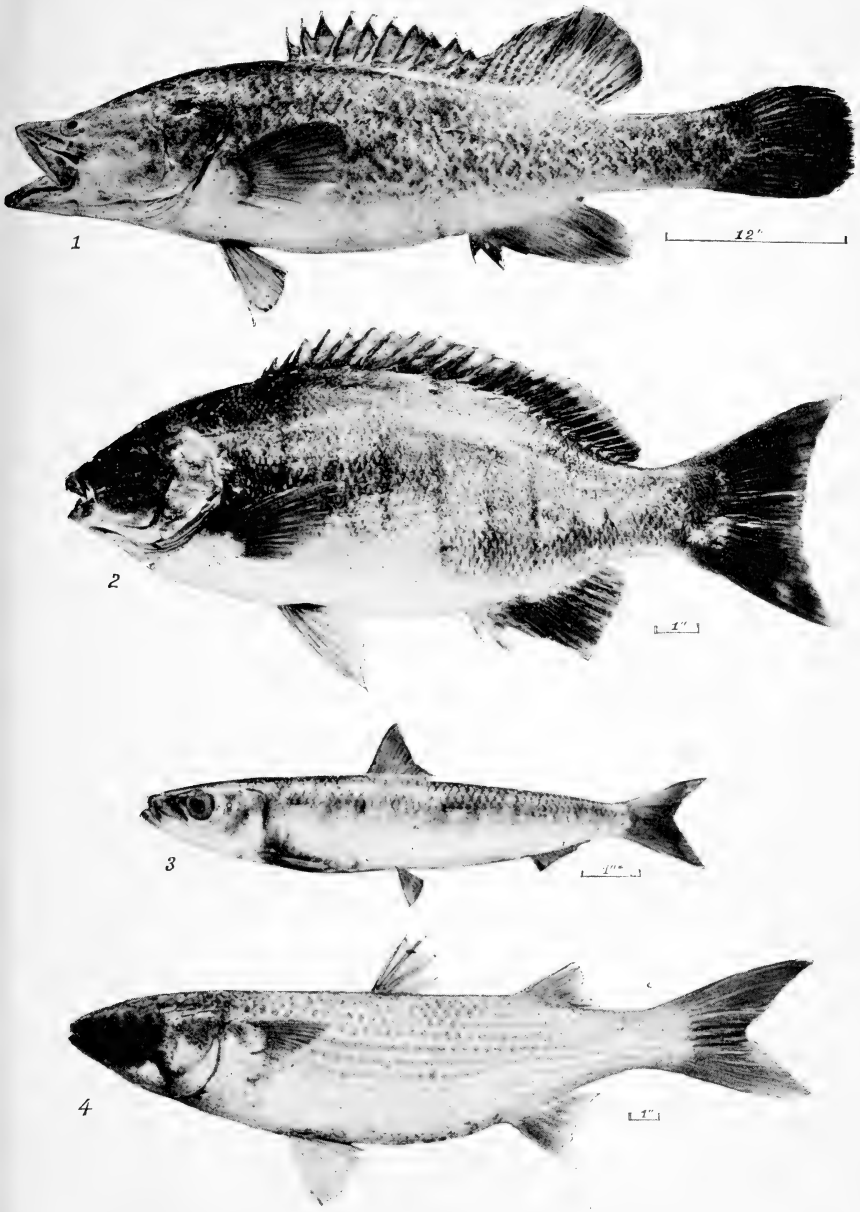
On page 17 of my "Edible Fishes of New South Wales," I drew attention to "the great and widespread movement towards the elucidation of fisheries problems which has begun to manifest itself during the last few years in the various States of Australia, led by New South Wales." I also mentioned the investigation ship which was then under

construction in New South Wales for the Federal Government, and the opportunities its operations would afford of adding to the store of knowledge of our marine denizens. It is particularly pleasing to me now to here place on record that, at my suggestion, the then Prime Minister (the Right Honorable Alfred Deakin, P.C., M.P.) caused the name of " Endeavour " to be bestowed on this vessel at her launching, in memory of the faithful little " Endeavour " of our gallant navigator Cook. The new " Endeavour " has since begun her work of exploration, and has for some time been operating in southern waters in the vicinity of Tasmania and Bass Strait.

It is to be sincerely hoped that the Commonwealth Government will lose no time in having the " results " of the " Endeavour's " cruises fully and accurately worked up and published for the benefit of Australia generally—and no doubt this will be done. In whatever part of Australia's waters she works, a knowledge of the results of her operations will be immediately of value to the various Fisheries Departments of the individual States.

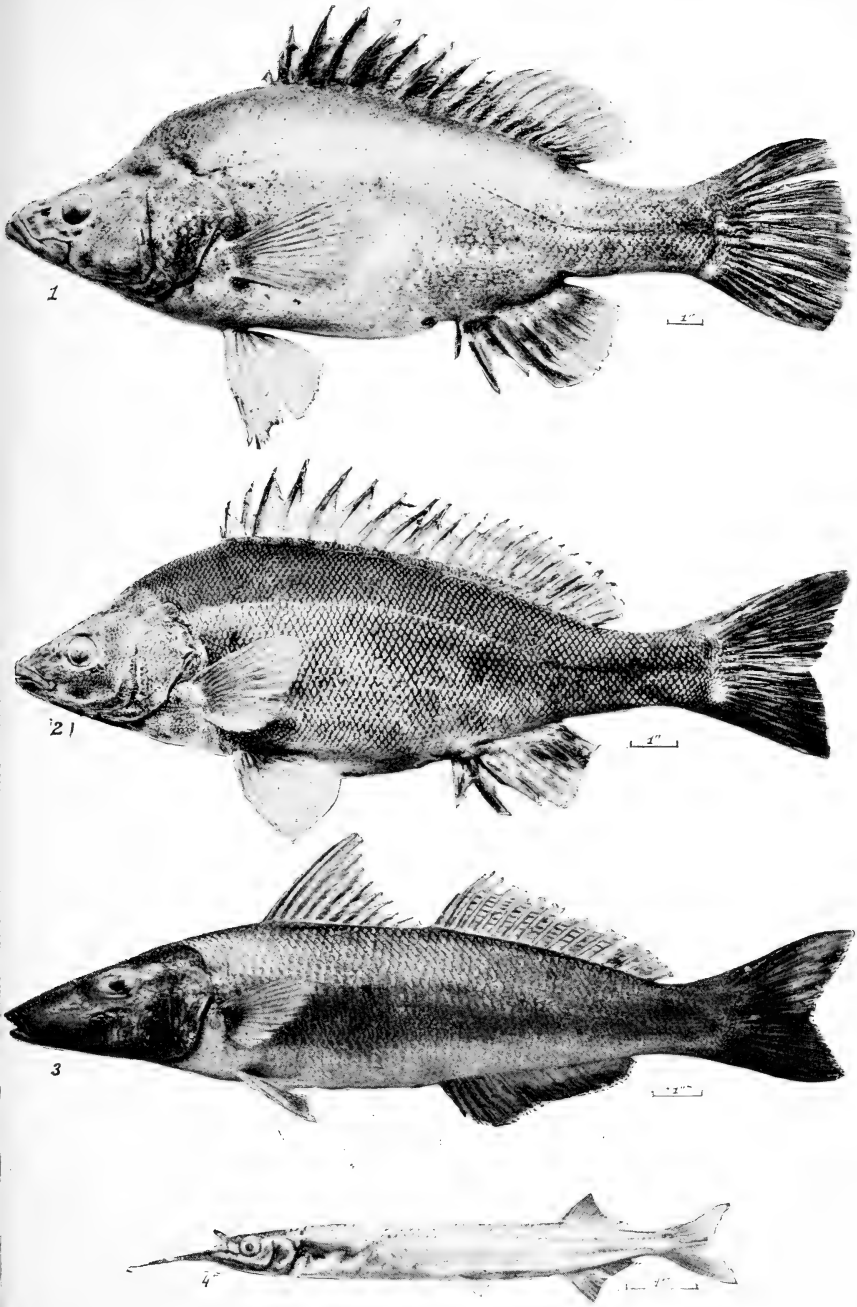
[*The vignette on the back of the wrapper represents the common "Squid" of New South Wales.*]

SYDNEY :
WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER.
1910.



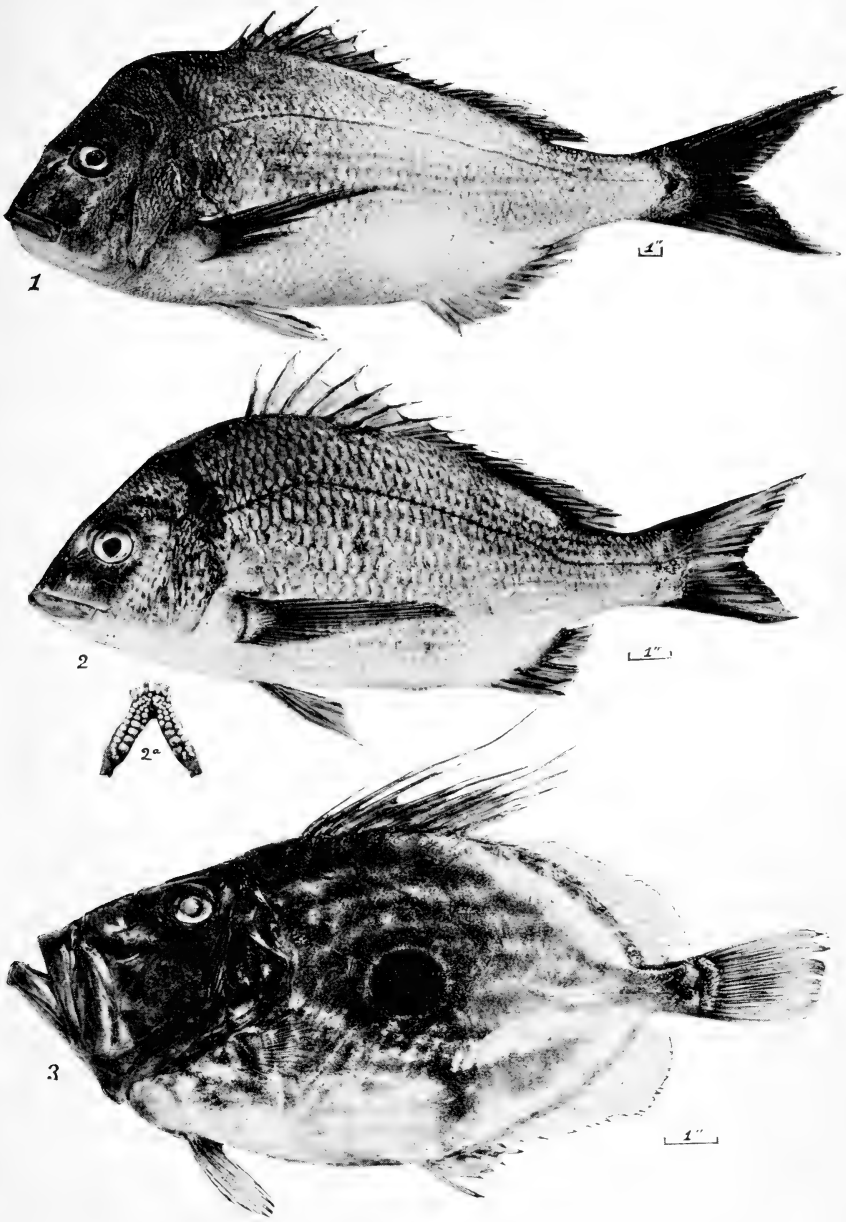
SOME COMMON FISHES OF NEW SOUTH WALES.

(1) MURRAY COD, *Oligorus macquariensis* (Cuv. and Val.). (2) BLACKFISH, *Girella tricuspidata* (Quoy and Gaimard). (3) AUSTRALIAN PILCHARD, *Clupanodon neopilchardus* (Steindachner). (4) SEA MULLET, *Mugil dobula* (Günther).



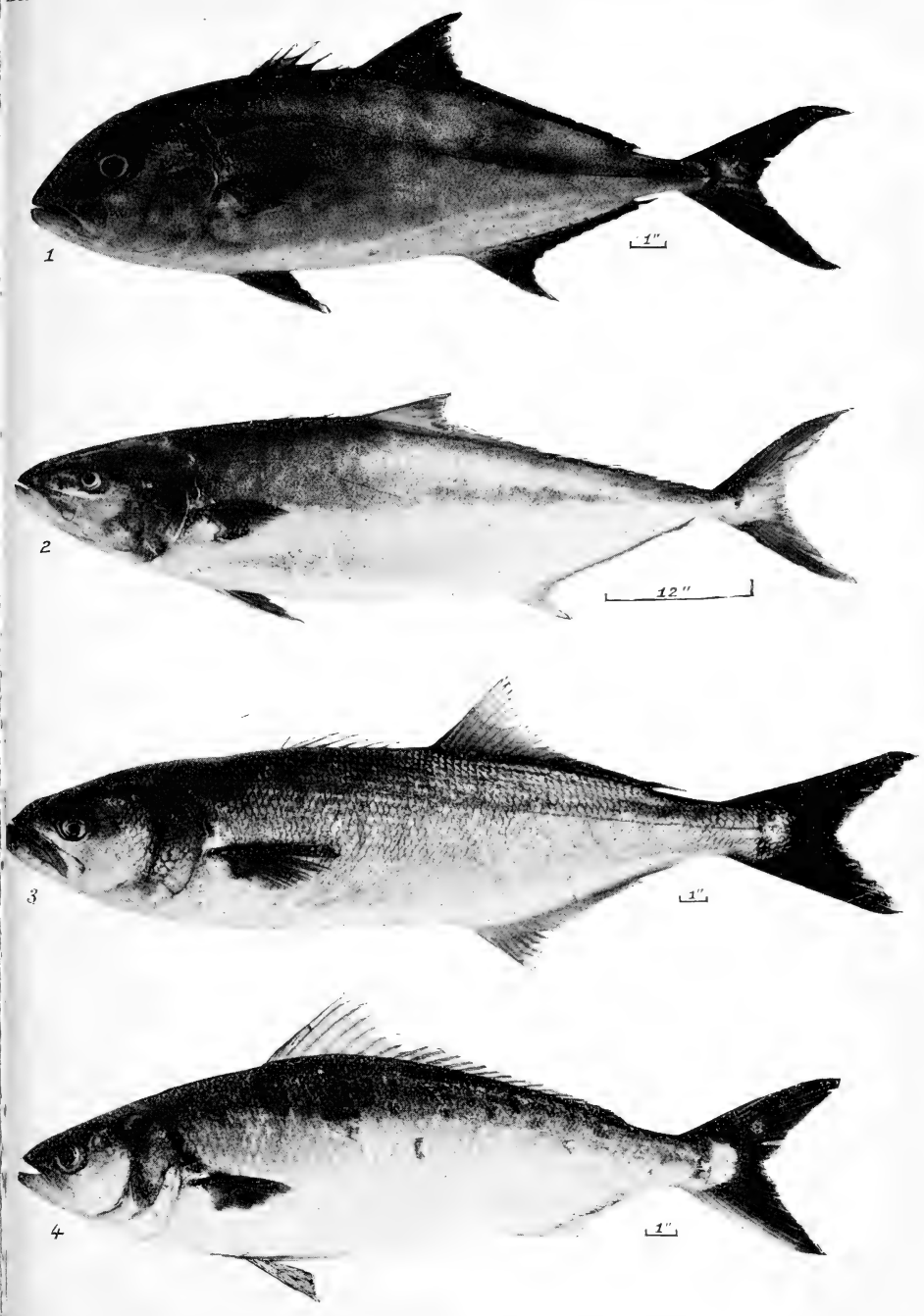
SOME COMMON FISHES OF NEW SOUTH WALES.

(1) GOLDEN PERCH or "YELLOW BELLY," *Plectroplites ambiguus* (Richardson). (2) SILVER PERCH or "GRUNTER," *Terapon ellipticus* (Richardson). (3) SAND WHITING, *Sillago ciliata* (Cuv. and Val.). (4) RIVER GARFISH, *Hemirhamphus regularis* (Günther).



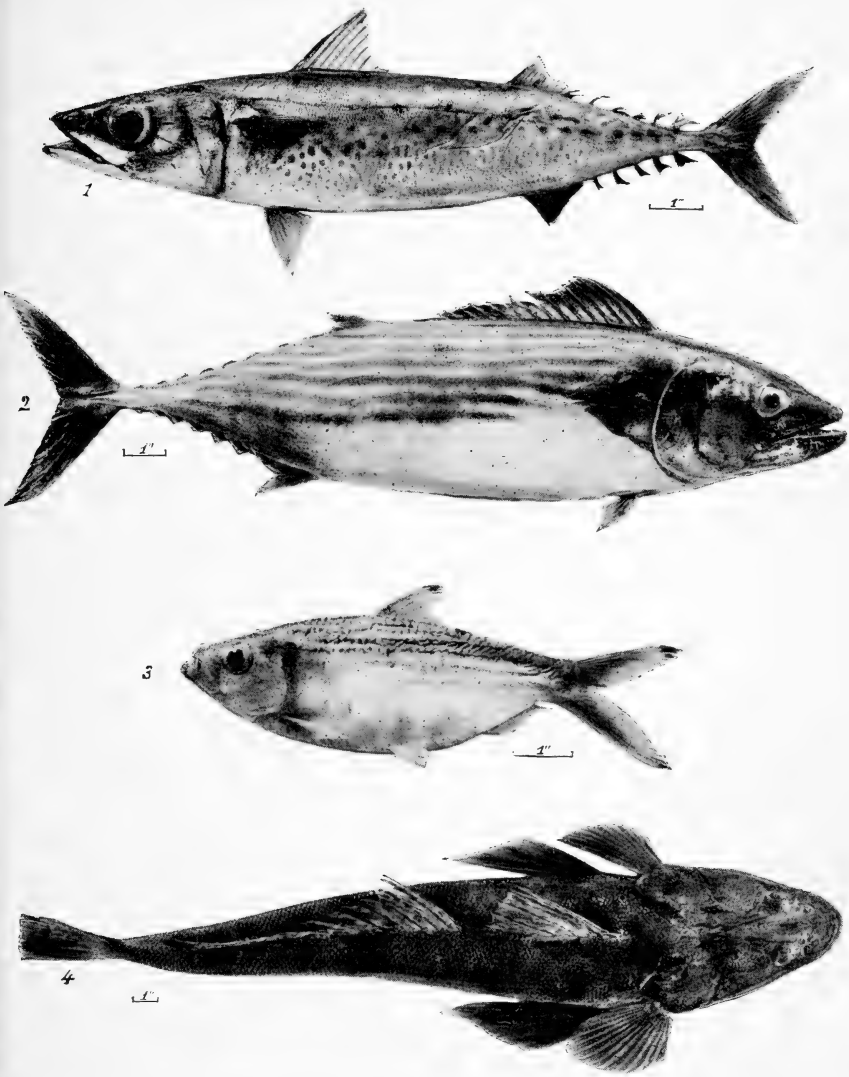
SOME COMMON FISHES OF NEW SOUTH WALES.

(1) SNAPPER, *Pagrosomus auratus* (Forster). (2) BLACK BREAM, *Chrysophrys australis*, Günther. (2a) Lower jaw of same, showing molars. (3) AUSTRALIAN JOHN DORY, *Zeus australis*, Richardson.



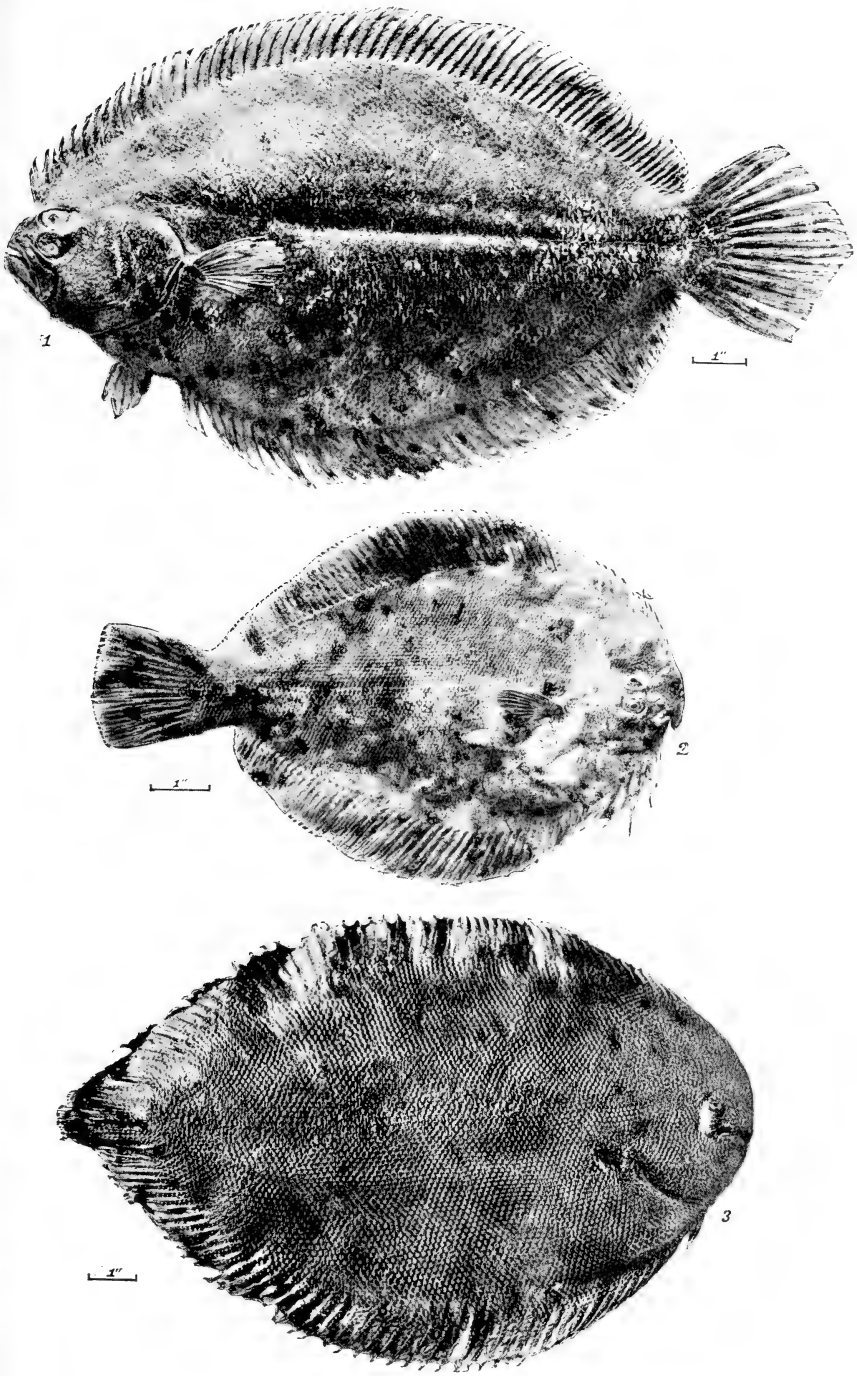
SOME COMMON FISHES OF NEW SOUTH WALES.

SAMSON-FISH, *Seriola hippos*, Günther. (2) KINGFISH, *Seriola lalandi*, Cuv. and Val. (3) TAILER, *Pomatomus saltatrix* (Linnæus). (4) AUSTRALIAN "SALMON" or "BUCK," *Arripis trutta* (Forster).



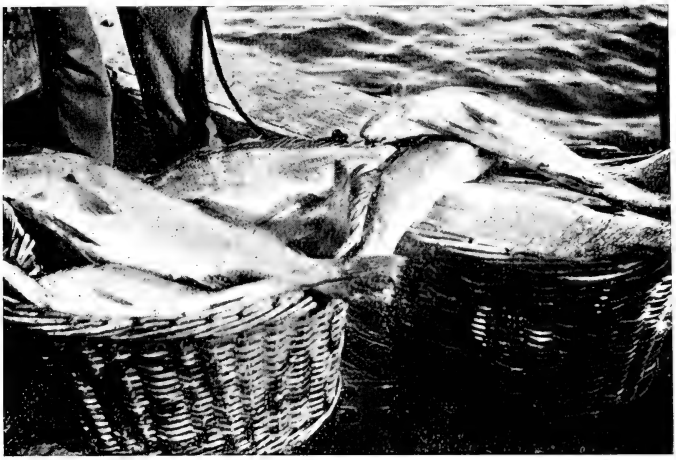
SOME COMMON FISHES OF NEW SOUTH WALES.

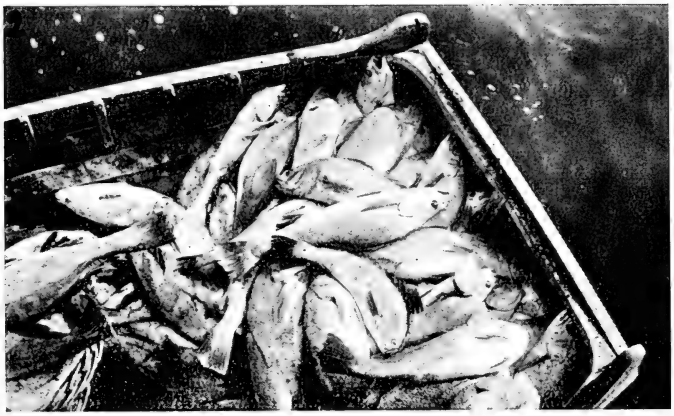
(1) COMMON MACKEREL, *Scomber colias*, Gmelin. (2) HORSE MACKEREL, *Sarda chilensis*, Cuv. and Val. (3) COMMON (N.S.W.) HERRING, *Sardinella castelnaui* (Ogilby). (4) DUSKY FLATHEAD, *Platycephalus fuscus*, Cuv. and Val.



SOME COMMON FISHES OF NEW SOUTH WALES.

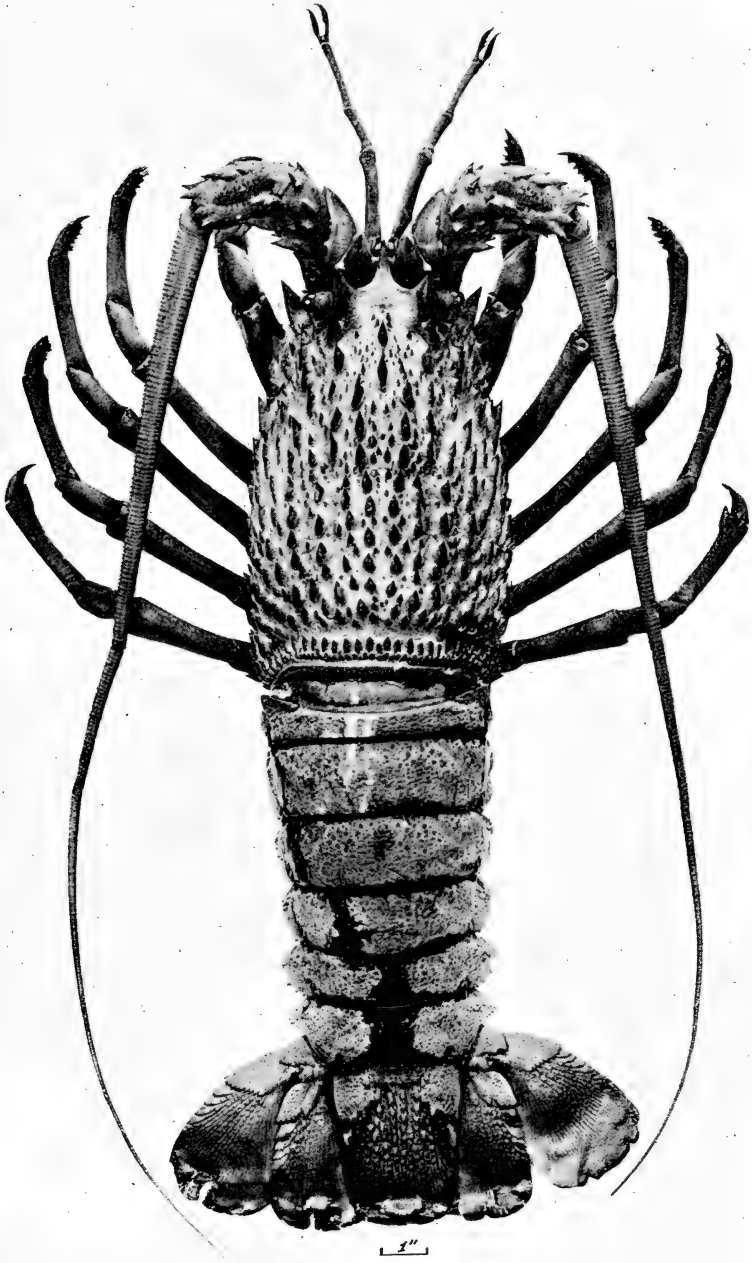
(1) SMALL-TOOTHED FLOUNDER, *Paralichthys novæ-cambriæ*, Ogilby. (2) LONG-SNOUTED FLOUNDER, *Ammotretis rostrata*, Günther. (3) BLACK SOLE, *Synaptura nigra*, Macleay.



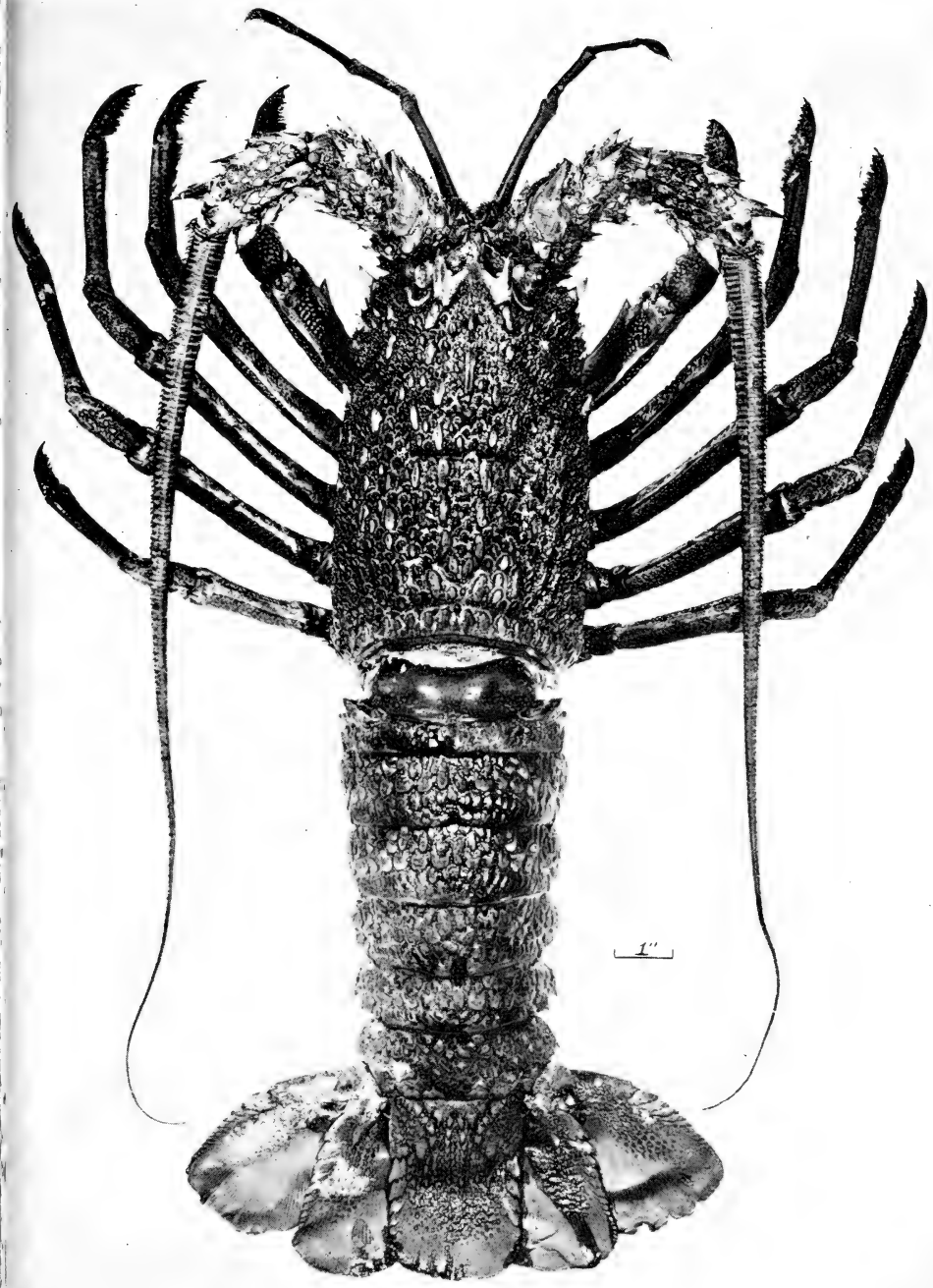


(1) and (2) Part of catch of over 600 Jewfish (*Sciæna antarctica*), averaging about 12 to 15 pounds weight, netted at Ulmarra (Clarence River). As many more were let go. (*J. McKern, Photo.*)

(3) Killer (*Orca gladiator*) and Little Piked Whale(*Balænoptera acutorostrata*), both about 30 feet long, cast up on Haslem's Beach, Twofold Bay.



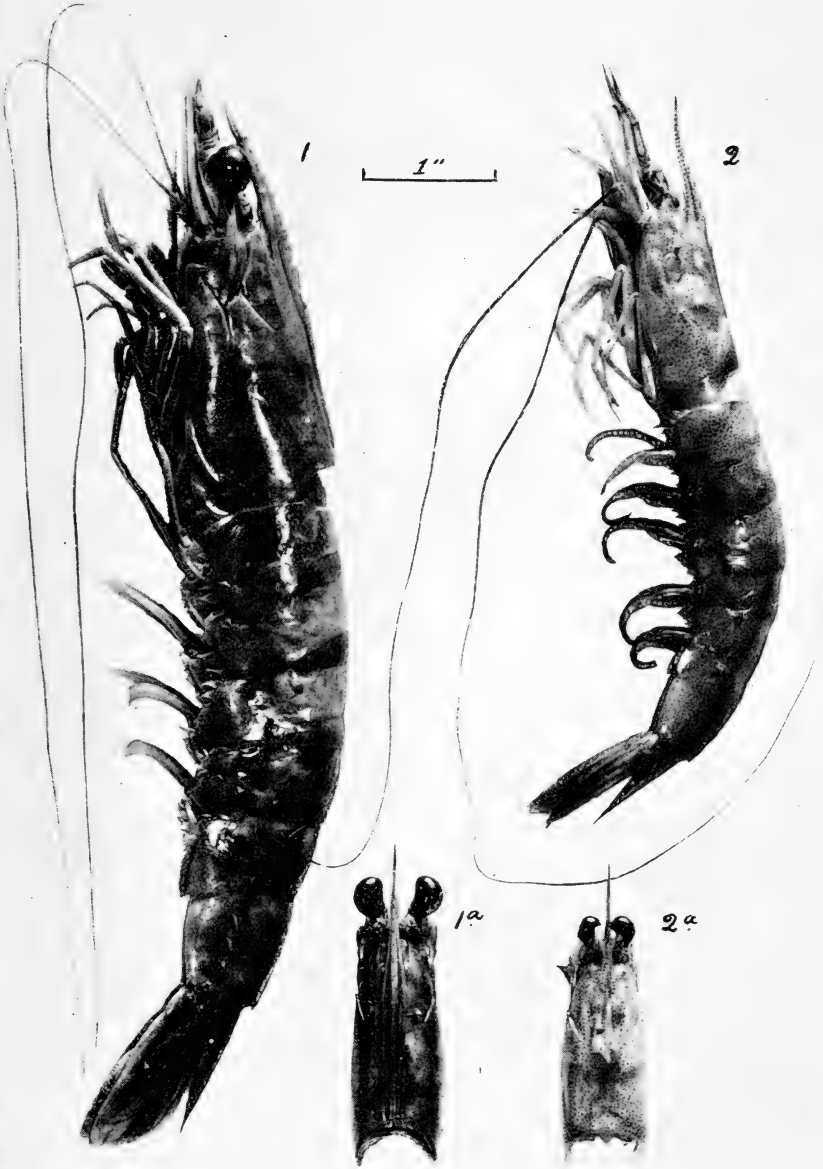
Common Crayfish (Marine), *Palinurus hugelii*, Heller.



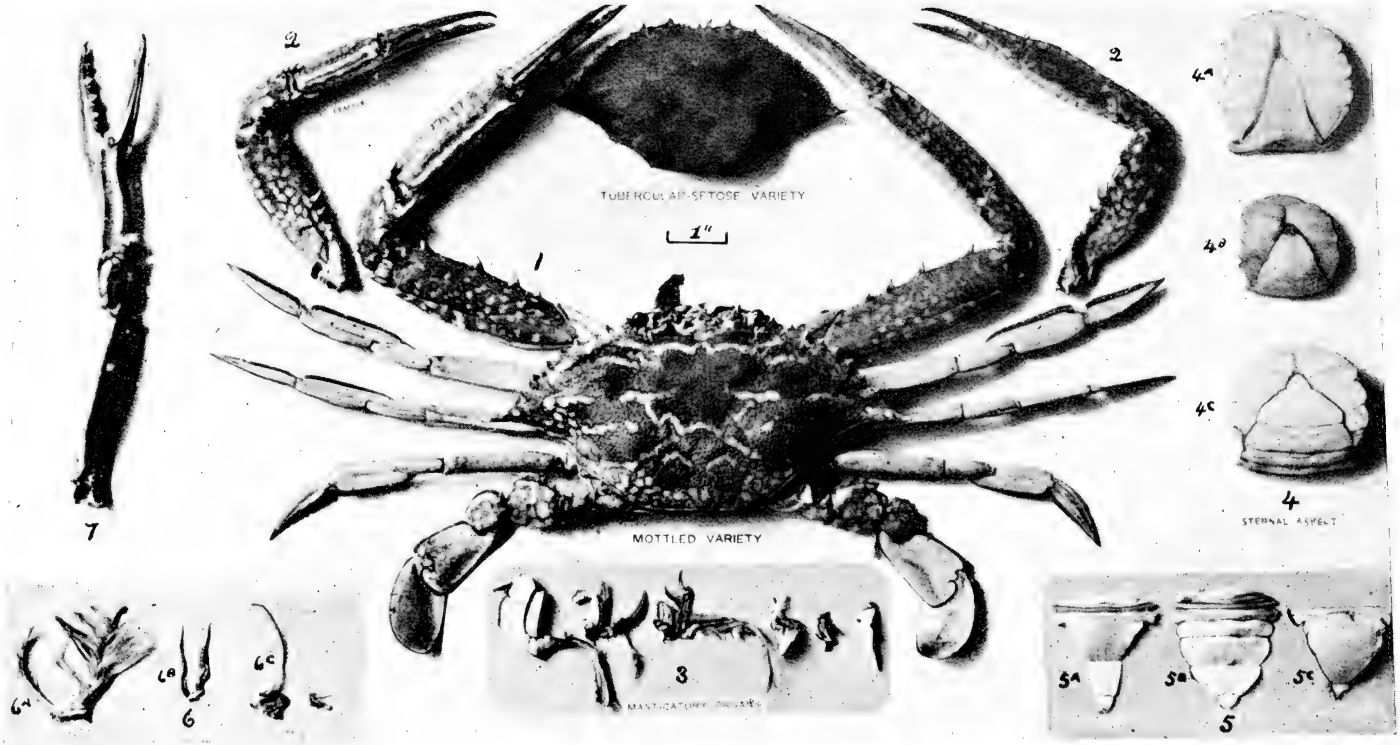
SOUTHERN CRAYFISH (Marine), *Palinurus edwardsii*, Miers.

Murrumbidgee Crayfish, *Astacopsis spinifera*, Heller.

Tiger Prawn, *Penæus monodon*, Fabricius.

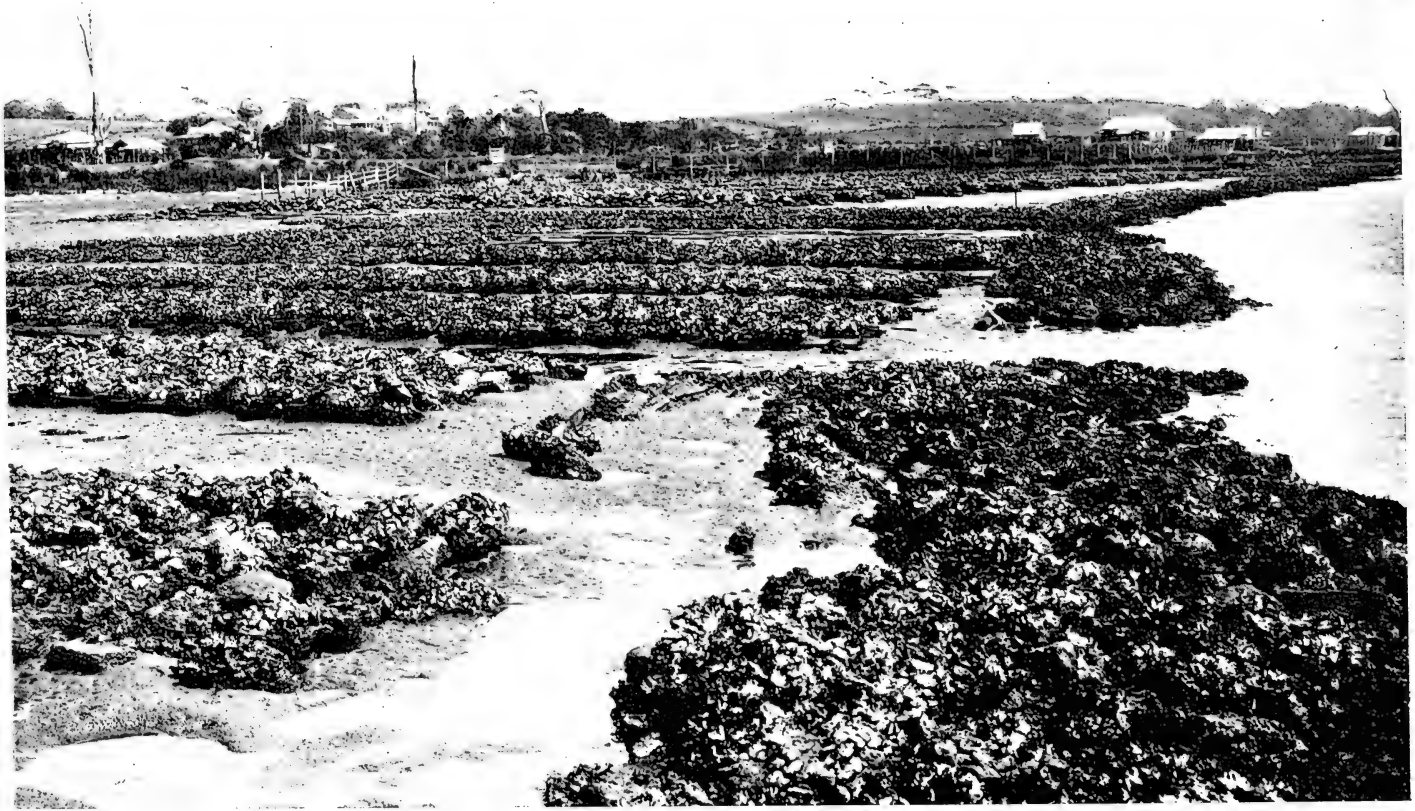


(1) King Prawn, *Penæus canaliculatus*, Olivier.
(2) School Prawn, *Penæus macleayi*, Haswell.
(1a) "Head" or carapace of same.
(2a) Carapace of same.



BLUE SWIMMING CRAB, *Lupa pelagica* (Linnæus).

(1) Large male. (2) Chelipeds of female of same sized body as No. 1. (3) Organs of mastication. (4) Sternal, or ventral, aspect of (4*a*) male, (4*b*) immature female, and (4*c*) mature female. (5) Pleons or "tails" of male, female, and immature female. (6) Pleopoda, or "tail appendages" of female, immature female, and male. (7) Distorted cheliped of large male.



OYSTER FARMING IN NEW SOUTH WALES.

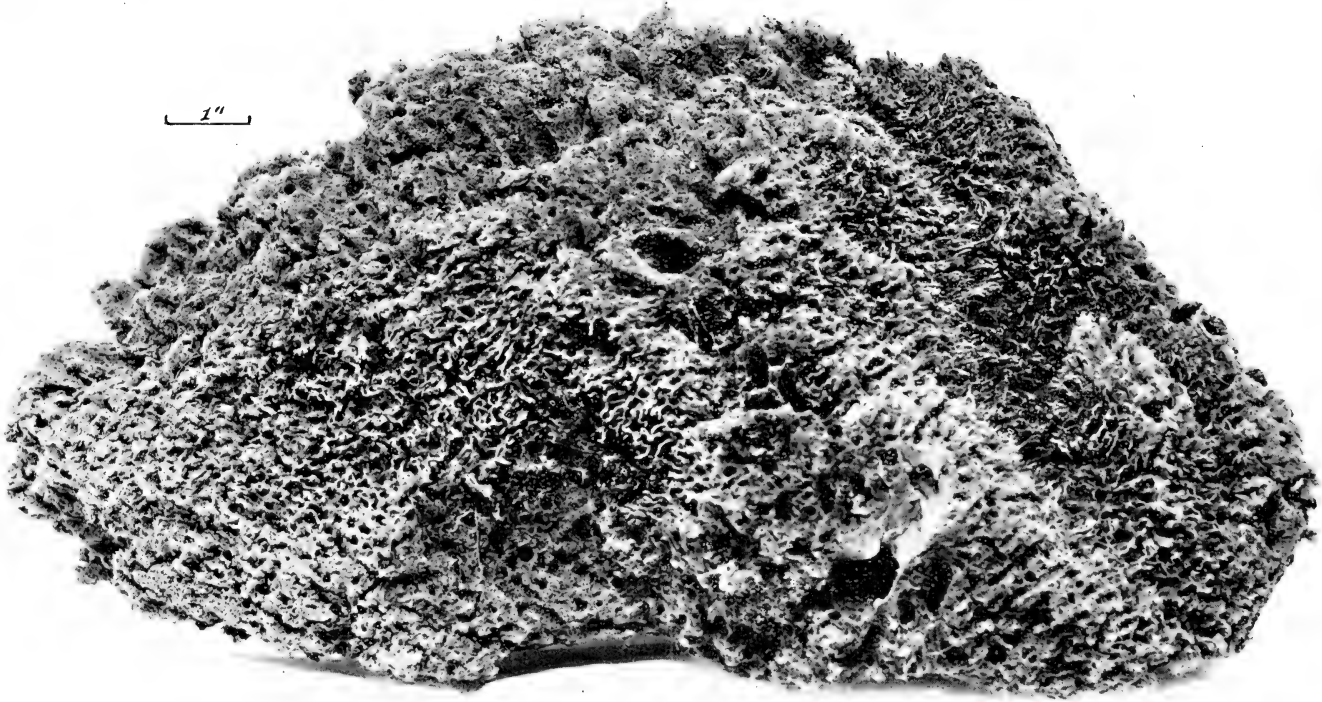
A view taken on one of Thomas Dick's leases at Port Macquarie, showing method of putting layers of stones in parallel rows, leaving room between each for punt to pass up and down at high tide. *Note* the effect of cultivation on an otherwise unpromising foreshore.

OYSTER FARMING IN NEW SOUTH WALES.

A view taken on one of Thomas Dick's leases at Port Macquarie, showing a patch of cultivated oysters on loose stone lying on a natural gravel bottom. These oysters are in a marketable condition.

OYSTER FARMING IN NEW SOUTH WALES.

(1) Fine growth on hardwood stake, and (2) on stone; both from F. J. Gibbins' Oyster Leases at Camden Haven. (3) Good growth, 15 months old, on terra-cotta tile, from J. W. Swainson's areas at George's River, Botany Bay.



A Common Commercial Sponge of New South Wales.